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'Gubba Seed News Compiled & Edited by Gubba Deepthi on behalf of Gubba cold' email: deepthi@gubbagroup.com

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India's largest Circulated Seed News Magazine

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GUBBA
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How Jagruk krishak made a difference to this women farmer.

EXCLUSIVE

Maya Devi, the Jagruk Krishak

"I was the first one to adopt change in my village, and I am the one progressing faster than the rest," shares Maya, brimming with pride.

In village Sotaka Bas in Alwar, Rajasthan, vegetable farming is done mostly by women. Contrary to popular belief, women here make up an active farming community. Maya Devi, a middle-aged woman and a mother of two is adorned with confidence that she never had before.

Maya is a small landholder, and she cultivates seasonal vegetables. What makes her stand apart from her fellow neighboring farming women is her curiosity to learn and adapt to advancements. Until a year ago, Maya was getting low returns and even lower quality of produce in comparison to her efforts and hard work. "If we were not told about soil testing, we would not have known how important micronutrients are for the crop," says Maya, expressing her gratitude.

This region of Alwar, Rajasthan, has poor soil quality and a high deficiency in important minerals needed for healthy growth of any crop. The farming community of the region is unaware of the soil health. Under the project Jagruk Krishak supported by IDRF, the Sehgal Foundation team conducted soil testing and educated the farming women in Sotaka Bas about micronutrients required in soil to grow a healthy crop. During field days conducted as part of training and demonstration sessions, Maya Devi and other farmers witnessed the difference in the growth of vegetables with their prevalent agricultural methods when compared to vegetables grown in soil with added micronutrients. Maya saw and understood the importance of zinc, boron, potash, sulphur, and other important micronutrients that act as food for the soil.

Maya Devi's journey from a krishak (farmer) to a jagruk krishak (conscious farmer) has resulted in increased self-confidence, the ability to make informed agricultural decisions, as well as increased crop productivity and profits thereafter. She is ready for her next plantation of cauliflower and tomatoes. From the savings of her earlier produce (lady finger, brinjal, and green chili), she has decided to install a drip irrigation unit in her field, a progressive decision to further water-saving in agriculture.

Jagruk Krishak Maya Devi is unstoppable. She inspires many around her with her undaunted spirit to become better and innovate in little ways. She affirms, **"Small steps can make a big difference."**

Editor's Letter

Dear Seedmen,

Thanks to the bountiful rain! This year's Rabi is extremely plentiful. The soil is expected to be dressed with golden maize. Our seed industry is exuberant about the busy business activity.

The Monsoon season has ended with a countrywide excess rain of 10%, apparently after 25 years. ground reserves and reservoirs have replenished to sufficiently grow the winter crops. We hope to see happy seedmen with profitable sales.

Happy reading the issue!

Gubba Kiran, CEO
Gubba Cold Storage Ltd.
Kiran@gubbagroup.com

Current Affairs

Below, is a story which we found taken from the history which we thought might interest you to know about the man who impacted, initiated the system of irrigation which is now developed on his idea.

SIR ARTHUR COTTON, THE ENGINEER AND HIS RICE BOWL

Sir Arthur lambasted the Raj for its neglect of India and described himself as a man with one idea that could make a difference here: irrigation

In 1877, at the height of the Great Famine that devastated the south, a distinguished Englishman, recently knighted for services rendered to the British empire, yet again took a vociferous stand against the policies of his queen's government in India. For years he had railed against imperial overzeal for the railways—a sophisticated scam that funnelled out Indian resources while delivering unconscionable profits to faraway investors—and now he was vindicated. For **"we have before our eyes,"** he noted, **"the sad and humiliating scene of magnificent (rail) Works that have cost poor India 160 millions, which are so utterly worthless in the respect of the first want of India, that millions are dying by the side of them."** The railways certainly brought grain to starving masses, but the costs were so disproportionately high that nobody could afford to buy them—official profiteering perverted even the delivery of famine relief.

Sir Arthur Cotton had made a career of crossing the line where India was concerned, taking stands that irritated his superiors even as they earned him much local admiration—two districts of Andhra Pradesh hold an estimated 3,000 statues of the man. He was, of course, as much an imperialist as his peers, but it was not a desire to bring glory to Great Britain that motivated him. Instead, this 10th son of the 10th son of a regrettably named Sir Lynch Cotton had experienced a religious awakening as a young man in 1826. Thereafter, he felt his mission was to work **"for the glory of God…and the benefit of men"**, and with familiar racial condescension, he decided that the men in question were poor brown Indians. His self-righteousness, however, was wedded to sincerity—having taken up the Indian cause, Sir Arthur never gave up, describing himself as **"a man with one idea"** that could make a difference in India: irrigation.

Sir Arthur was a military engineer who caused his colleagues great consternation by refusing to be awed by steel and steam. He had no dispute with the railways but it made no sense to him that extortionate technology should be imposed on a landscape where the basics had been entirely neglected. But then he was also somewhat naive—he once argued against the term **"collector"** since it suggested that revenue officials' sole interest lay in extracting money, when surely they were also responsible for that other thing called development. The architects of the Raj, of course, were under no such delusions—the collector was there precisely to collect, and Sir Arthur's lifelong mistake lay in hoping that India's wants would also somehow feature in those exploitative calculations masquerading as government policy. Naturally, he was thwarted by **"administrative jealousy"**, and many were those who called him a **"wild enthusiast"** with **"water in his head"**. Still, Sir Arthur was tireless. In 1827, after inspecting the second century Kallanai dam near Tanjore, he regretted that "this work, which had a population of perhaps one hundred thousand and a revenue of £40,000 dependant upon it, had not been allowed £500 to keep it in repair." He personally rode out to persuade his superiors to correct this, only to be rebuffed. **"Government,"** he was told, "could not squander such sums as this upon the wild demands of an Engineer." "Is it surprising," he asked in dismay, that "the natives thought us savages?" Nevertheless, he kept up his interest in irrigation—learning from furloughs in Australia, as well as travels in lands as diverse as Egypt and Syria—till finally he was able to leave a real imprint along the eastern coast of India; something his daughter called "The Redemption of the Godavari District" through, as his brother chuckled, "The Cheap School of Engineering"—also known today by that Indian word, jugaad.

The British, Sir Arthur thought, brought "disgrace to (their own) civilized country" by their "grievous neglect" of India. He decided to make amends. When the Godavari project was sanctioned in 1847, Sir Arthur asked for six engineers, eight juniors and 2,000 masons. Instead, he was allotted one "young hand", two surveyors, and a few odd men. Yet he persevered. "To save on masonry work," Jon Wilson writes, "he copied the method of construction" used by the Cholas. "Cotton created a loose pile of mud and stone on the riverbed, which he then covered in lime and plastered with concrete, instead of building up entirely with stone." The whole project was finished at a third of the cost initially estimated, till 370 miles of canals (339 of which were navigable) irrigated some 364,000 acres of land, transforming a dry expanse into the "rice bowl" of Andhra Pradesh. And waterways, the Englishman demonstrated, were a doubly rewarding alternative to rail transport, simultaneously nourishing the farmlands of rural Indians.

In the end, however, Sir Arthur couldn't prevail over the railway lobby. Between 1885-87, the railways cost £2.84 million while the irrigation budget stagnated at a measly £6,130. As late as 1898, the year before his death, it was stated that rail absorbed "so large a measure of Government attention, (that) irrigation canals, which are far more protective against famine...are allowed only one-thirteenth of the amount spent on railways each year." It was easier, Sir Arthur sniffed, to propose a £4 million railway project over a £40,000 irrigation scheme. He had no dearth of ideas, however, offering a pan-India river-linking project, and bombarding his bosses with notes and suggestions till they finally established, almost out of sheer exhaustion, a public works department—the ubiquitous "PWD" of today. And after collecting his shiny knighthood, he continued to cheerfully lambast the Raj for its neglect of India, receiving a more profound honour instead from ordinary peasants, who, to this day, remember Sir Arthur less as a representative of the Raj and more as a local saviour.

Source Live Mint

SEED LOBBY WANTS GOVT TO DO AWAY WITH MSP, PRICE-CONTROL REGIME

Calls for long-term policy direction

The Federation of Seed Industry of India (FSII) has asked the government to do away with the Cottonseed Price Control order and the minimum support price (MSP). It felt that agriculture should be treated as as an industry.

"The government should not interfere in the pricing of agricultural inputs, especially seeds and fertilisers, and leave the pricing to be determined by open markets," it said.

The MSP, it felt, is distorting the market and not benefiting anyone. **"It is, in fact, rewarding inefficiencies. Instead of MSPs and subsidies, it can offer a premium over market price to farmers, instead of interfering with the market forces,"** it said.

The ₹18,000-crore seed industry also called for introduction of a National Agricultural Policy and expedition of the Seed Bill and Biotech Regulatory Authority of India (BRAI) Bill to ensure policy direction and predictability.

'Ineffective regulation'

An ineffective regulatory body, disregard for intellectual property rights and highly unpredictable policies are adversely impacting the fortunes of seed companies and farmers, the Federation of Seed Industry of India (FSII), which represents 41 seed companies, said.

"A policy that provides a long-term vision for research and development, agronomics and climate resilient practices will ensure agricultural security, which is as important as national security. We need an Agricultural Council on the lines of Goods and Services Tax Council to resolve issues related to agriculture quickly," VR Kaundinya, Director-General of FSII, told BusinessLine.

The association, formed mostly by the agri-biotech companies, recently submitted a memorandum to Devendra Fadnavis, the Chief Minister of Maharashtra and the Convenor of the High-Powered Committee of Chief Ministers' for Transformation of Indian Agriculture.

Biotech regulation

"Biotechnology regulation has not progressed much in the last nine years. As a result technologies such as HT cotton, GM mustard and brinjal haven't progressed much. We need clarity and predictability in approvals," he said.

He claimed that biotech research in agriculture has suffered in the last few years. The member-companies of FSII represent 65 per cent of the size of Indian seed industry. They constitute close to 75 per cent of about ₹600 crore that seed industry spend on research and development.

"As it is the average quantum of R&D spend by a seed firm is very low at 3 per cent as against 10-12 per cent globally. There is a huge scope for improvement if proper policies and regulation are in place," he felt.

The government should ease the GM regulatory process. It should declare its GM strategy and intentions very clear to all stakeholders. The association wants a consultative process to bring alignment and uniformity across States in the implementation of the Seed Act. **"Currently, there is a considerable mismatch between States, especially in terms of product approvals for marketing,"** he said.

Demand driven agri

"From a production driven agriculture, we are moving to demand driven agriculture. It is important to understand the demand side dynamics by involving the end user industries in planning agricultural production," the association sad in the representation to the high-powered committee.

भारत का राजपत्र
The Gazette of India

THE GAZETTE OF INDIA : EXTRAORDINARY
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
(Department of Agriculture, Cooperation and Farmers Welfare)
ORDER

New Delhi, the 21st August, 2019

G.S.R. 593(E).— In exercise of the powers conferred by section 3 of the Essential Commodities Act, 1955 (10 of 1955), the Central Government hereby makes the following order further to amend the Seeds (Control) Order, 1983, namely: —

1. (1) This order may be called the Seeds (Control) Amendment Order, 2019.

(2) It shall come into force on the date of its publication in the Official Gazette.

2. In the Seeds (Control) Order, 1983, in clause 6, relating to 'period of validity of Licence', for the words **"three years"**, the words "**five years"** shall be substituted.

[F. No. 13-157/2019-SD.IV]
ASHWANI KUMAR, Jt. Secy.

Note: The Principal notification was published in the Gazette of India, Extraordinary, Part II, Section 3, Subsection (i) vide number G.S.R.932 (E), dated the 30th December, 1983 and subsequently amended vide G.S.R. 444(E), dated 26th July, 2006, G.S.R. 890 (E), dated 12th December, 2014 and G.S.R. 547(E), Dated 2nd June, 2017.

Research

India's Extreme Weather Requires Big Data Analytics to Deliver Big Results to Farmers

Farmers around the world are facing the challenge of adapting to weather extremes and variability due to climate change. As a recent Al Jazeera report explains, this is especially true for India which has seen flooding in the north and drought in the south as the monsoon becomes increasingly erratic. At aWhere, we want farmers to be empowered with accurate weather data and insights based on crop and pest models to increase their resilience to weather variability.

Indian farmers have been particularly impacted this year with flooding in the north and drought and a delayed monsoon in other regions (seen in the map above). Weather variability has disrupted traditional farming practices that are usually signaled by the first rains of the monsoon. This traditional planting signal is not as reliable and can lead to premature planning and crop failure.

However, with the advent of cloud computing and diverse weather sources we can generate accurate weather data to empower farmers with appropriate recommendations to minimize production risks and maximize profits.

The reality is that farming is a data-intensive enterprise, yet farmers often operate in a data-poor environment. We believe this must change, and new public-private partnerships are emerging to adapt effectively to climate change. aWhere does offer a key component of this equation by generating a global observed weather surface (over 1.7 million virtual weather stations) over the past decade to gain insights into how our weather is changing and appropriate responses to manage these changes. Our weather insights help farmers, input providers, processors, and retail companies ensure farmers are profitable and can manage production risks to ensure safe, affordable, and nutritious food to consumers. Let's harness the power of big data to deliver tailored solutions to big challenges like climate change and build economic resilience.

Source : awhere

10 Breakthrough Technologies Can Help Feed the World Without Destroying It

How can the world feed nearly 10 billion people by 2050 while also advancing economic development, protecting and restoring forests, and stabilizing the climate?

It won't be easy and will require major new efforts, but it can be done. **Our new World Resources Report:** Creating a Sustainable Food Future, co-issued by the World Bank, UN Environment Programme and UN Development Programme, recommends a menu of 22 solutions served over five courses:

1. Reduce growth in demand;
2. Increase food production without expanding agricultural land;
3. Increase fish supply;
4. Reduce greenhouse gas emissions from agricultural production; and
5. Protect and restore natural ecosystems.

This menu enables the world to close the gap between the food available today and that needed by 2050, without clearing more land for farming and while reducing the food system's greenhouse gas emissions to a level aligned with the Paris Agreement on climate change.

Course Menu of Solutions can reduce agricultural emissions by more than 70%

Some items in the menu require more farmers to implement best practices that already exist today. Others need consumers to change behavior, or governments and businesses to reform policies.

The challenge is sufficiently large, however, that many solutions will require technological innovations. Advancing them is a major theme of our report. Here are 10 important examples:

1) Plant-based meat

Globally, per gram of edible protein, beef and lamb use around 20 times the land and generate around 20 times the greenhouse gas emissions of plant-based proteins. Affordable plant-based products that mimic the experience of eating beef could reduce growth in global beef consumption, while still satisfying meat-lovers.

Fortunately, companies such as Impossible Foods and Beyond Meat are already making headlines by creating plant-based **"beef"** that looks, sizzles, tastes and even bleeds like the real thing.

2) Extended shelf lives

About one-third of food is lost or wasted between the farm and the fork. Fruits and vegetables are a common food item wasted in more developed markets. One breakthrough to address this is the emergence of inexpensive methods that slow the ripening of produce.

Companies are already investigating a variety of natural compounds to do so. For example, Apeel Sciences has an array of extremely thin spray-on films that inhibit bacterial growth and retain water in fruit. Others include Nanology and Bluapple, whose technologies delay decomposition.

3) Anti-gas for cows

About a third of all greenhouse gas emissions from agricultural production (excluding land-use change) come from **"enteric"** methane released as cow burps. Several research groups and companies are working on feed compounds that suppress the formation of methane in cows' stomachs.

Dutch-based DSM has a product called 3-NOP that reduces these methane emissions by 30% in tests, and does not appear to have health or environmental side effects.

4) Compounds to keep nitrogen in the soil

About 20% of greenhouse gas emissions from agricultural production are related to nitrogen from fertilizer and manure on crops and pastures. The majority of these emissions come from the formation of nitrous oxide as microorganisms transfer nitrogen from one chemical form to another.

Compounds that prevent these changes, including coatings on fertilizers and so-called **"nitrification inhibitors,"** can reduce nitrogen losses and increase the amount of nitrogen taken up by plants, leading to lower greenhouse gas emissions and less water pollution from fertilizer runoff.

Without a regulatory push, research into such technologies has stagnated, but great potential remains.

Some new compounds have emerged in just the past year.

5) Nitrogen-absorbing crops

Another way to chip away at nitrous oxide emissions is to develop crop varieties that absorb more nitrogen and/or inhibit nitrification. Researchers have identified traits to inhibit nitrification in some varieties of all major grain crops, which others can now build upon through crop breeding.

6) Low-methane rice

Around 15% of greenhouse gas emissions from agricultural production come from methane-producing microorganisms in rice paddies.

Researchers have identified some common rice varieties that emit less methane than others, and they've bred one experimental strain that reduces methane emissions by 30% in the laboratory.

Despite this promise, there is no consistent effort in any country to breed and encourage the uptake of low-methane rice varieties.

7) Using CRISPR to boost yields

Two broad items on the menu for a sustainable food future involve boosting yields on existing cropland and producing more milk and meat on existing grazing land. One way to boost crop yields sustainably (without over-application of fertilizers or over-extraction of irrigation water) is to unlock traits in crop genes that increase yields.

CRISPR technology, which enables more precise turning on and off of genes, has the potential to be revolutionary in this regard.

8) High-yield oil palm

Dramatic growth in demand for palm oil, an ingredient found in everything from shampoo to cookies, has been driving deforestation in Southeast Asia for decades, and now threatens forests in Africa and Latin America. One way to reduce this threat is to breed and plant oil palm trees with 2-4 times the production per hectare of conventional trees.

Potential for higher-yielding oil palm trees already exists. The company PT Smart, for instance, has a variety with triple the current average yield of Indonesia's oil palm trees.

These high-yield varieties need to be used in new plantations and when farmers restock current plantations with new trees (typically done every 20 or more years).

9) Algae-based fish feeds

Another element of a sustainable food future is to reduce pressure on wild fish stocks. As the global fish catch has peaked, fish farming, or **"aquaculture,"** has grown to meet world fish demand. However, aquaculture can increase pressure on the small wild fish species used as feed ingredients for larger farmed fish.

One technological innovation to circumvent this challenge is to create substitute feeds using algae or oilseeds that contain the omega-3 fatty acids found in wild fish-based oils. Some companies are moving to produce algae-based aquaculture feeds, and researchers have created a variety of canola that contains omega-3s.

10) Solar-powered fertilizers

The production of nitrogen-based fertilizers uses vast quantities of fossil fuels and generates significant emissions, roughly 85% of which result from the production of hydrogen to blend with nitrogen.

Many have invested in solar energy to produce hydrogen for fuel-cell vehicles, but similar technologies can also help produce low-carbon fertilizers. Pilot plants are under construction in Australia.

Rapidly Deploying Technology for a Sustainable Food Future

Despite their potential, none of these measures are moving forward at adequate speed and scale. Research funding for agricultural greenhouse gas mitigation is miniscule and needs to be increased, in part by making better use of the $600 billion in existing public support each year for agriculture globally.

In addition, although many of the technologies above have the potential to save money even in the near-term, many cost more than their conventional counterparts today. Increasing their uptake will require not only more public research funds, but also flexible regulations that give private companies stronger incentives to innovate. For example, in areas where technologies are underdeveloped, such as compounds that reduce enteric methane, governments could commit to requiring the use of these compounds if a product achieves a certain level of cost-effectiveness in mitigation (such as $25 per ton of carbon dioxide equivalent).

As another example, governments could require fertilizer companies to increasingly blend in compounds that reduce nitrogen loss. The good news is that for virtually every type of advancement needed in the food system, small groups of scientists with limited budgets have already identified promising opportunities. Today's plant-based burgers that taste like real beef were developed and brought to market in fewer than 10 years. Feeding a growing world population in the face of climate change and resource constraints is an enormous challenge. The technological innovations listed above aren't the only ones the food system needs, and of course we won't solve the challenge through technology alone.

However, just as in other sectors like energy and transport, technological innovation is an essential ingredient of a sustainable future.

Source: potatopro

TOON TIME

Interesting Fact

HEIRLOOM

These are seeds that are handed down from one generation to the next. During the 1900's we experienced a drop in the number of heirloom varieties, because gardeners stopped saving and trading their seeds. When we rely on seed companies any variety that sells slowly simply get dropped from production and disappear. This loss of varieties translates into lower genetic variability in our food plants. Lower variability means less adaptability to stresses such as disease or climate change.

Happy Happenings at Gubba

New Borns

Mr M Sridhar
(Lift Boy, Y6)
Blessed with
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Highlights

- First of its kind in India.
- Radio shuttle racking systems for fast operations.
- Centralised monitoring system of temperature.
- 2 Pre-cooling chambers.
- Biggest cold storage facility for eggs in India.

General

Seedmen Association 24th Annual General Meeting

Seedsmen Association is serving the farming community and in particular seed companies since 1995 and it is the largest and oldest seed industry association in the country. The members of the association are spread over in both the states of Andhra Pradesh, Telangana and other parts of the country, at present the association has a diverse membership of 460 seed companies operating at various locations in the country.

The Association conducted its 24th Annual General Meeting on 18th September 2019 at K.L.N. Prasad Auditorium, FTAPCCI, Red Hills, Hyderabad. The senior members of the association/Past Presidents and the Office Bearers were invited to the dais the President, SMA welcomed the gathering and explained the challenges before the Seed Industry and the present scenario of the industry.

Dr. Y. Yogeshwar Rao Past President, Sri. G.V. Bhaskar Rao Past President and Sri. A S N Reddy Past President addressed the gathering with suggestions to work hard, maintain quality and look for sustainability. Also advised the members to be united and deal the issues with the Government etc.

The Secretary & Treasurer Presented their reports on various activities taken up by the Association, further explained the role played by the seed industry for the farmers is a continuous programme always looking for up-scaling the productivity and quality as such the challenges to the seed industry in the next decade are daunting requiring huge capital investments in technology, manpower, processing and other infrastructure development.

The Association conducted its regular business duly discussing / deliberating as per the Agenda and the members actively participated in the discussions and also highlighted the various problems being faced by the industry.

Further the Association has the tradition of honouring eminent personalities every year during the AGM where in the SMA Awards will be given to the individuals, like every year this year too, during this 24th AGM the following personalities were felicitated for their valuable contributions.

I. **Lifetime Achievement Category :** **Sri. A S N Reddy, COO**
M/s. SIRA Seeds Pvt. Ltd.

II. **Seed Grower Category :**
(i) Sri. Nooka Gopi Reddy
Dist. Kurnool.
(ii) Sri. Yamapuram Mallaiah
Nizamabad District.

III. **Late S. Venkat Reddy Memorial Award :**
Sri. K. Shiva Prasad
DDA, (Seeds) O/o. C&DA, Telangana.

IV. **Seed Entrepreneur Category:**
M/s. Shriram Bioseed Genetics India Ltd.
Hyderabad. (Dr. Sharad Sharma)

V. **Seed Scientist Category : (i) Dr. Chandra Mohan Reddy**
Sr. Scientist, RARS, Nandyal, Kurnool Dist.
(ii) Dr. K. Parimala
Sr. Scientist, SRTC, PJTSAU, Hyderabad

VI. **Allied Industry Category : Sri. R. Srinivas Rao, Director**
M/s. Coral Print Pack Pvt. Ltd. Hyderabad

The Vice President proposed Vote of Thanks to the dignitaries and all the members

NOSTALGIA

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International

Nebraska team merges machine learning, plant genetics to maximize sorghum potential

Through a $2.7 million grant from the U.S. Department of Energy, a University of Nebraska–Lincoln research team is developing ways to maximize sorghum potentials across the United States.

Sorghum, the third most abundant cereal crop in the United States, is emerging as a star player in the biofuels industry. With its water use efficiency, resistance to heat and low cost of seed, it has the capacity to outpace corn, especially in the West and High Plans where irrigation supply limits agricultural productivity more than land availability. Right now, however, maximizing the crop's potential is challenging. The function of much of its genome – its complete set of DNA – remains a mystery. Without pinpointing the function of more of sorghum's roughly 30,000 genes, researchers can't fully optimize sorghum for biofuel production.

That's the problem a group of University of Nebraska-Lincoln researchers, led by plant geneticist James Schnable, has set out to address. The team recently earned a $2.7 million, three-year grant from the U.S. Department of Energy to develop a rapid, efficient method for characterizing the functions of genes in sorghum.

The Nebraska scientists are leading a team of institutions from across the Corn Belt — including Iowa State University, Michigan State University, Purdue University and the University of Illinois at Urbana-Champaign — in this effort.

Their approach, an innovative merger of machine learning and plant genetics, will pave the way for sorghum strains designed to thrive in specific environments. The method could also extend to other crops like corn and soybeans, the vast majority of whose genes are unstudied.

"If we understand the details about how plants perceive and react to their environments, we can develop varieties specialized to certain parts of the U.S.," said Schnable, associate professor of agronomy and horticulture. "Right now, for many genes, we have no idea what they do." To begin to fill these gaps, Schnable's team is using a method known as reverse genetics. It's essentially a rewind of the traditional approach, called forward genetics, where the starting point is a plant with an unusual appearance, or phenotype. Researchers find the odd-looking plant, then try to determine which genes are responsible.

With reverse genetics, the process moves the other direction. Scientists start with a known gene, alter that specific gene, then analyze the characteristics of the resulting plant, shedding light on the gene's function. Though the approach has been used for more than a decade, in most cases, altering the gene has no effect. Identifying the right genes to study is like digging for a needle in a haystack.

To overcome this, Schnable's team is devising a systematic method for selecting which genes it makes sense to investigate. It centers on machine learning — the process of teaching computers to make decisions by exposing them to mountains of previously collected data. For this project, the researchers will feed the machine extensive information about sorghum and corn genes that already have been studied in depth.

From this data, the computer will learn to recognize patterns indicating a certain type of gene likely plays an outsize role in determining sorghum's characteristics. Once refined, the algorithm will spare researchers the cumbersome process of randomly picking a gene, mutating it and coming up empty-handed.

By measuring the water use of plants on an hourly or even minute-by-minute basis, Nebraska's James Schnable and colleagues hope to better understand and eventually improve how crops respond to drought.

Along with researching sorghum, Schnable also is developing a stalk-worn sensor for corn that will help his team better understand and eventually improve how it responds to drought.

"People in the lab have found that when a gene does yield something weird in the plant, these genes look really different from others in the genome," Schnable said. "We're going to use this information to train computers to identify other genes likely to have big effects on plants when they're mutated." After the system identifies promising genes, Schnable's team will edit them and measure the resulting sorghum for traits like stress response, nutrient and water use efficiency, and biomass – the amount of organic material available to produce renewable energy.

To this point, much research has focused on identifying crop varieties that perform well across large parts of the country, from eastern Nebraska to central Illinois, for example. But with a deeper understanding of how sorghum's genes function, the focus can shift to developing breeds that flourish in smaller geographical pockets with fewer inputs. This strategy could boost overall sorghum production for fuel, food and animal feed.

The project is among the first to marry artificial intelligence and plant science, a combination that started gaining momentum over the past 18 months, Schnable said. He expects the method to open new doors in plant genetics.

"There is so much potential when you start communicating between two different academic silos that haven't been talking to each other before," he said.

The interdisciplinary approach is reflected in the team's composition. The Nebraska group also includes Yufeng Ge, associate professor of biological systems engineering, and Brandi Sigmon, assistant professor of practice in plant pathology. Researchers from other universities include statisticians, engineers and geographers. The project is funded by DOE's Genomics-enabled Plant Biology for Determination of Gene Function program.

Source : agropages

Why CRISPR-edited crops should be allowed in organic agriculture

University of California, Berkeley professor stands at the front of the room, delivering her invited talk about the potential of genetic engineering. Her audience, full of organic farming advocates, listens uneasily. She notices a man get up from his seat and move toward the front of the room. Confused, the speaker pauses mid-sentence as she watches him bend over, reach for the power cord, and unplug the projector. The room darkens and silence falls. So much for listening to the ideas of others. Many organic advocates claim that genetically engineered crops are harmful to human health, the environment, and the farmers who work with them. Biotechnology advocates fire back that genetically engineered crops are safe, reduce insecticide use, and allow farmers in developing countries to produce enough food to feed themselves and their families.

Now, sides are being chosen about whether the new gene editing technology, CRISPR, is really just **"GMO 2.0"** or a helpful new tool to speed up the plant breeding process. In July, the European Union's Court of Justice ruled that crops made with CRISPR will be classified as genetically engineered. In the United States, meanwhile, the regulatory system is drawing distinctions between genetic engineering and specific uses of genome editing.

For many, perception of genetically modified foods has changed little from those of this protester dressed as a genetically altered 'Killer Tomato' marching through downtown

I am a plant molecular biologist and appreciate the awesome potential of both CRISPR and genetic engineering technologies. But I don't believe that pits me against the goals of organic agriculture. In fact, biotechnology can help meet these goals. And while rehashing the arguments about genetic engineering seems counterproductive, genome editing may draw both sides to the table for a healthy conversation. To understand why, it's worth digging into the differences between genome editing with CRISPR and genetic engineering.

What's the difference between genetic engineering, CRISPR and mutation breeding?

Opponents argue that CRISPR is a sneaky way to trick the public into eating genetically engineered foods. It is tempting to toss CRISPR and genetic engineering into the same bucket. But even **"genetic engineering"** and **"CRISPR"** are too broad to convey what is happening on the genetic level, so let's look closer.

In one type of genetic engineering, a gene from an unrelated organism can be introduced into a plant's genome. For example, much of the eggplant grown in Bangladesh incorporates a gene from a common bacterium. This gene makes a protein called Bt that is harmful to insects. By putting that gene inside the eggplant's DNA, the plant itself becomes lethal to eggplant-eating insects and decreases the need for insecticides. Bt is safe for humans. It's like how chocolate makes dogs sick, but doesn't affect us.

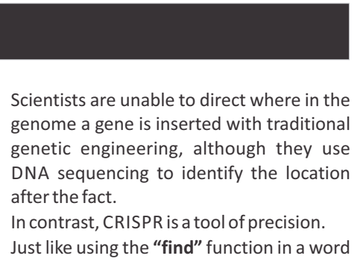
Another type of genetic engineering can move a gene from one variety of a plant species into another variety of that same species. For example, researchers identified a gene in wild apple trees that makes them resistant to fire blight. They moved that gene into the **"Gala Galaxy"** apple to make it resistant to disease. However, this new apple variety has not been commercialized.

Scientists are unable to direct where in the genome a gene is inserted with traditional genetic engineering, although they use DNA sequencing to identify the location after the fact.

In contrast, CRISPR is a tool of precision.

Just like using the **"find"** function in a word processor to quickly jump to a word or phrase, the CRISPR molecular machinery finds a specific spot in the genome. It cuts both strands of DNA at that location. Because cut DNA is problematic for the cell, it quickly deploys a repair team to mend the break. There are two pathways for repairing the DNA. In one, which I call **"CRISPR for modification,"** a new gene can be inserted to link the cut ends together, like pasting a new sentence into a word processor.

In **"CRISPR for mutation,"** the cell's repair team tries to glue the cut DNA strands back together again. Scientists can direct this repair team to change a few DNA units, or base pairs (A's, T's, C's and G's), at the site that was cut, creating a small DNA change called a mutation. This technique can be used to tweak the gene's behavior inside the plant. It can also be used to silence genes inside the plant that, for example, are detrimental to plant survival, like a gene that increases susceptibility to fungal infections.Mutation breeding, which in my



In genetic engineering, a new gene is added to a random location in a plant's genome. CRISPR for modification also allows a new gene to be added to a plant, but targets the new gene to a specific location. CRISPR for mutation does not add new DNA. Rather, it makes a small DNA change at a precise location. Mutation breeding uses chemicals or radiation (lightning bolts) to induce several small mutations in the genomes of seeds. Resulting plants are screened for beneficial mutations resulting in desirable traits.

opinion is also a type of biotechnology, is already used in organic food production. In mutation breeding, radiation or chemicals are used to randomly make mutations in the DNA of hundreds or thousands of seeds which are then grown in the field. Breeders scan fields for plants with a desired trait such as disease resistance or increased yield. Thousands of new crop varieties have been created and commercialized through this process, including everything from varieties of quinoa to varieties of grapefruit. Mutation breeding is considered a traditional breeding technique, and thus is not an "excluded method" for organic farming in the United States.

CRISPR for mutation is more similar to mutation breeding than it is to genetic engineering. It creates similar end products as mutation breeding, but removes the randomness. It does not introduce new DNA. It is a controlled and predictable technique for generating helpful new plant varieties capable of resisting disease or weathering adverse environmental conditions.

Opportunity lost – learning from genetic engineering

Most commercialized genetically engineered traits confer herbicide tolerance or insect resistance in corn, soybean or cotton. Yet many other engineered crops exist. While a few are grown in the field, most sit all but forgotten in dark corners of research labs because of the prohibitive expense of passing regulatory hurdles. If the regulatory climate and public perception allow it, crops with valuable traits like these could be produced by CRISPR and become common in our soils and on our tables.

Dr. Peggy Lemaux, holding seeds from the hypoallergenic wheat she helped develop with genetic engineering

For example, my adviser at UC Berkeley developed, with colleagues, a hypoallergenic variety of wheat. Seeds for this wheat are held captive in envelopes in the basement of our building, untouched for years. A tomato that uses a sweet pepper gene to defend against a bacterial disease, eliminating the need for copper-based pesticide application, has struggled to secure funding to move forward. Carrot, cassava, lettuce, potato and more have been engineered for increased nutritional value. These varieties demonstrate the creativity and expertise of researchers in bringing beneficial new traits to life. **Why, then, can't I buy bread made with hypoallergenic wheat at the grocery store?**

Loosening the grip of Big Agriculture

Research and development of a new genetically engineered crop costs around US$100 million at large seed companies. Clearing the regulatory hurdles laid out by the U.S. Department of Agriculture, EPA and/or FDA (depending on the engineered trait) takes between five and seven years and an additional $35 million. Regulation is important and genetically engineered products should be carefully evaluated. But, the expense allows only large corporations with extensive capital to compete in this arena. The price shuts small companies, academic researchers and NGOs out of the equation. To recoup their $135 million investment in crop commercialization, companies develop products to satisfy the biggest markets of seed buyers – growers of corn, soybean, sugar beet and cotton.

The costs of research and development are far lower with CRISPR due to its precision and predictability. And early indications suggest that using CRISPR for mutation will not be subject to the same regulatory hurdles and costs in the U.S. A press release on March 28, 2018 by the U.S. Department of Agriculture says that **"under its biotechnology regulations, USDA does not regulate or have any plans to regulate plants that could otherwise have been developed through traditional breeding techniques"** if they are developed with approved laboratory procedures.

If the EPA and FDA follow suit with reasonable, less costly regulations, CRISPR may escape the dominant financial grasp of large seed companies. Academics, small companies and NGO researchers may see hard work and intellectual capital yield beneficial genome-edited products that are not forever relegated to the basements of research buildings.

Common ground: CRISPR for sustainability

In the six years since the genome editing capabilities of CRISPR were unlocked, academics, startups and established corporations have announced new agricultural products in the pipeline that use this technology. Some of these focus on traits for consumer health, such as low-gluten or gluten-free wheat for people with celiac disease. Others, such as non-browning mushrooms, can decrease food waste.

The lingering California drought demonstrated the importance of crop varieties that use water efficiently. Corn with greater yield under drought stress has already been made using CRISPR, and it is only a matter of time before CRISPR is used to increase drought tolerance in other crops. Powdery mildew-resistant tomatoes could save billions of dollars and eliminate spraying of fungicides.

A tomato plant that flowers and makes fruit early could be used in northern latitudes with long days and shorter growing seasons, which will become more important as climate changes.

The rules are made, but is the decision

Dave Chapman, owner of Long Wind Farm, checks for insects on organic tomato plant leaves in his greenhouse in Thetford, Vt. Chapman is a leader of a farmer-driven effort to create an additional organic label that would exclude hydroponic farming and concentrated animal feeding operations.

In 2016 and 2017, the U.S. National Organic Standards Board (NOSB) voted to exclude all genome-edited crops from organic certification.

Source : geneticliteracyproject.org